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ABSTRACT

The need for and availability of management skills training for foreign graduate students of engineering was surveyed. A survey instrument also sought to identify: the effectiveness of current practices in the teaching of management skills; current credit and advising policies related to taking management courses; and a rating of a variety of possible academic programs that address the need for management skills training. Of the 197 deans of engineering at U.S. universities offering graduate engineering programs who were mailed the questionnaire in March 1982, responses were received from 67 institutions. Results indicate that the provision of management skills to foreign engineering students needs to be addressed. Managerial functions are viewed as an important part of the work of the successful practicing engineers. Deans saw little evidence that universities are currently effective in teaching managerial skills to their foreign engineering students. Deans' responses indicated that they felt generally that graduate schools of engineering are not currently providing managerial training in their master's degree in engineering program. Most engineering schools did not give credit for general management courses, and most schools of management/business courses appear to be oversubscribed and therefore closed to nonmajors. Programs, information, and individuals who could serve as resources to the development/implementation of teaching management skills to foreign engineering students are identified. Additional contents include a literature review and discussion of the issues, a list of participating institutions, a questionnaire, and a bibliography. (SW)

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Management Skills Training for Foreign Engineering Students:

An Assessment of Need and Availability

Stephen C. Dunnett

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National Association for Foreign Student Affairs, Washington, D.C., 1982

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Preface

The National Association for Foreign Student Affairs (NAFSA), under a contract with the Agency for International Development (AID), commissioned a study to survey the need for and availability of management skills training for foreign graduate students of engineering. NAFSA awarded a grant to the International Executive Program in Management and English Language of the State University of New York at Buffalo to conduct the Management Skills Survey.

The principal investigator was Dr. Stephen C. Dunnett, Associate Professor of Education at the State University of New York at Buffalo. He was assisted by William White, a graduate assistant in the program in international trade of the Department of Geography, State University of New York at Buffalo.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Association for Foreign Student Affairs or the Agency for International Development.

Acknowledgments

This project could not have been completed without the encouragement and assistance of many individuals committed to the education of students from developing nations at U.S. institutions of higher education.

I wish to extend a special note of gratitude to my colleagues at the State University of New York at Buffalo who served on the NAFSA/AID Management Skills Survey Advisory Committee: Professor A. Donald Arsem of the School of Management; Professor George C. Lee, Dean of the Faculty of Engineering and Applied Sciences; and Dr. Joseph F. Williams, Director of the Office of International Student Affairs.

I am also grateful for the constant support and assistance provided by Richard Downie of the University of Florida at Gainesville, Willis Griffin of the University of Kentucky, Mary Ann Hood of the American University, and Martin Limbird of Iowa State University, who were members of the 1981–82 NAFSA/AID Projects Steering Committee.

Appreciation is expressed to the American Society of Engineering Education for their assistance in providing a mailing list of U.S. schools of engineering as well as to all the individuals who took time to complete the survey. Many sent additional information and helpful comments along with their responses.

Numerous foreign student advisers and foreign students provided much helpful data drawn from their own experiences. I regret that space does not permit acknowledgment of their contributions to this study by identifying them publicly.

I am much indebted to my research assistant, William White, of the Department of Geography of the State University of New York at Buffalo, for his dedication to the project and competence as a researcher.

Last but not least, I wish to express my gratitude to Kevin J. Schieffer, Director of NAFSA/AID Program, for his assistance in facilitating this project, and Thomas Ball, Assistant Director of the Office of International Training, Agency for International Development, for his sincere interest in the project and constant support. I am grateful to AID and NAFSA for the opportunity to conduct this survey, which I hope will contribute to the eventual enhancement of the education programs of students from developing countries enrolled in U.S. engineering schools.

Stephen C. Dunnett
State University of New York at Buffalo
June 1982

Introduction

For more than a decade, the National Association for Foreign Student Affairs (NAFSA) has worked closely with the Agency for International Development (AID) in the planning, organization, and support of projects and research studies designed to improve foreign student programs.

In 1978, the Office of International Training of AID awarded NAFSA a three-year contract to improve the relevancy of academic programs for AID participants and other foreign students from developing countries studying in the U.S. and to determine the met and unmet needs of foreign students from developing countries in the United States.

This resulted in two national studies conducted by NAFSA: one which examined the relevance of U.S. graduate education to foreign students, and the other which examined the needs of foreign students from developing countries at U.S. colleges and universities.[1]

Baron (1979) found that students from developing countries had serious difficulties in translating theoretical knowledge into practical application in their home environment. He further found that engineering students from developing countries were seldom able to articulate special academic interests relating to their projected professional work back home.

Lee (1981), in her comprehensive study of over 2,000 foreign students, found that the need least satisfied by educational programs was for practical

1. *The Relevance of U.S. Graduate Programs to Foreign Students from Developing Countries*, Marvin Baron (Washington, D.C.: National Association for Foreign Student Affairs, 1979). *Needs of Foreign Students from Developing Nations at U.S. Colleges and Universities*, Motoko Y. Lee, *et al.* (Washington, D.C.: National Association for Foreign Student Affairs, 1981).

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training experience while in the U.S. Needs for relevant education and for training to apply knowledge were emphasized by students in most fields of study. This was especially true of graduate students.

AID's Office of International Training in its 1981–82 contract with NAFSA took immediate action to respond to these unmet needs. Through NAFSA, it commissioned a study of the feasibility of practical training for foreign students. A grant was awarded by NAFSA to the University of Nebraska at Lincoln to develop principles for the design and implementation of practical training experiences for foreign students from developing countries enrolled in formal degree programs at colleges and universities in the United States.[2]

Through a separate grant to the State University of New York at Buffalo, NAFSA commissioned a second study to survey the need for and availability of management skills training for foreign graduate students of engineering. It is hoped that this study will be the beginning of a national effort to make graduate programs more relevant to the needs of foreign students from developing nations. NAFSA and AID also wish to encourage the acquisition of specialized skills concurrently with a foreign student's regular academic program of study.

Graduate foreign students in engineering programs were selected for this first survey, since engineering is the most popular field of study for foreign students. In 1980–81, 25.8 percent of all foreign students studying in the U.S. were in engineering. Business and management is the second most popular field, with 17.4 percent of all foreign students enrolled.[3]

There has been a perception among those who work with foreign graduate students of engineering that engineers in developing nations are working in conditions that are substantially different from the conditions in which a recent graduate working in the U.S. will work. Two situations, in particular, seem to come about—the engineer is placed more quickly in a position of responsibility, and this engineer will be expected to work without the supporting infrastructure that is taken for granted in developed nations. Because of these constraints, it is felt that the engineer working in a developing nation, and particularly the engineer working on large-scale development projects, needs to be able to oversee responsibilities of a wide-ranging nature.

The management skills survey sought to delineate these needs, to discover what policies U.S. universities currently follow vis-a-vis management skills training for engineers, and to stimulate discussion of the need for and

2. *Principles for Practical Training for Foreign Students*, Peter S. Levitov (Washington, D.C.: National Association for Foreign Student Affairs, 1982).

3. *Open Doors: 1980–81 Report on International Educational Exchange*, Douglas R. Boyan, editor (New York: Institute of International Education, 1981).

adequacy of such training. Dr. Stephen C. Dunnett, Associate Professor of Education and Co-Director of the International Executive Program in Management and English Language of the State University of New York at Buffalo and a member of the NAFSA/AID Steering Committee, was appointed by that committee to head the management skills survey. In September 1981, a research assistant, William White, a graduate student in the international trade program of the Department of Geography, State University of New York at Buffalo, was hired to assist Dr. Dunnett with this project.

The project team began its work with the following task-specific goals:

1. To establish an advisory committee that could advise the project team on management skills training for foreign engineering students from all relevant perspectives.
2. To search the appropriate literature for materials relevant to the goals of the project.
3. To contact and seek the opinions of individuals with a special interest in this topic.
4. To survey schools of engineering which have enrolled significant numbers of AID-sponsored students in an effort to determine their policies regarding management skills training for engineering students.
5. To follow up this survey with telephone interviews and personal visits to the most focal and/or most innovative schools.
6. To suggest alternative ways of providing management skills training for students from developing nations studying engineering in U.S. institutions of higher education.

The literature search was begun immediately and involved both computer and manual searches of indices and abstracts in the fields of education, management, and engineering. University computer library searches were conducted in cooperation with the staff of the State University of Buffalo library. In addition, a computer search was made of AID materials and publications. The results of the computer searches were disappointing. However, the items that were uncovered led to more appropriate bodies of literature that were not uncovered in the computer searches. Manual searching and browsing, particularly in the engineering education literature, brought to light the most relevant publications. In general, the literature search provided little of direct relevance to this study. The results of the literature reviews are included, together with a bibliography of relevant publications.

A local advisory committee, consisting of faculty members at State University of New York at Buffalo, was appointed early in the fall semester to advise the project team. This committee met to assist the project team in addressing the most pertinent issues, as well as to offer strategic advice. Mem-

bers were sought from the three campus areas most closely connected with the goals of this study: foreign student affairs, engineering, and management. The members of the committee were:

- Professor Donald Arsem, Co-Director, International Executive Program in Management and English Language,
- Dr. George C. Lee, Dean of the Faculty of Engineering and Applied Sciences,
- Dr. Joseph F. Williams, Director of the Office of International Student Affairs.

A fourth faculty member, although not formally a member of the committee, was also consulted for advice on project management and working conditions in developing nations. Dr. Ibrahim Jammal, of the State University of Buffalo's School of Architecture and Environmental Design, provided invaluable assistance in these areas.

After these initial steps had been taken, a project design was developed which outlined the scope of the problem and the course of action to be followed. This outline was presented at two NAFSA/AID seminars held in conjunction with the National Association of State Universities and Land Grant Colleges and the American Council of Graduate Schools. Discussions of relevant issues and suggestions for project direction were received after both presentations, and the project design was subsequently modified.

Enrollment data for AID-sponsored engineering students were obtained from AID. It was initially intended to survey those schools which had significant AID enrollments. Due to the rather small sample involved and some difficulties in identifying the engineering schools where AID participants were enrolled, it was decided by the project team to conduct a wide-ranging survey of all U.S. schools of engineering. Although it was realized that this might sacrifice data of direct interest to an evaluation of current AID programs, it was hoped that the broader approach would reveal opinions and data of a wider spectrum. The necessity of changing to this approach eliminated some opportunities for direct followup.

The survey instrument was developed and mailed to 197 deans of engineering at U.S. universities having graduate engineering programs. This information was obtained through the kind assistance of the American Society of Engineering Education (ASEE) in Washington, D.C. A list of institutions whose deans were sent surveys is included in Appendix B.

The survey sought to identify:

1. The need for engineering students to obtain management skills.
2. The specific management skills deemed most useful.
3. The effectiveness of current practices in the teaching of these skills.

4. Current credit and advising policies related to taking management courses at the surveyed institutions.
5. Programs, individuals, studies, etc., that addressed this problem.
6. A rating of a variety of possible academic programs which address the need for management skills training.

The results of this survey are presented later in this report. A copy of the survey instrument is provided in Appendix D.

Individuals interested in this matter continued to be contacted throughout the duration of the project. Authors of interesting articles, chairmen of academic departments, placement officials, and foreign students were consulted. This process was augmented by the suggestions of survey respondents.

While the survey was in progress, the project research assistant, William White, visited Washington. While there he discussed the project with NAFSA staff members, worked in the Library of Congress in search of further literature, obtained useful data from the American Society of Engineering Education, and contacted government officials in search of various reports. In addition, visits were made to AMIDEAST and the Engineering Administration Department of George Washington University.

A search of college catalogs was conducted in an attempt to uncover programs of interest. Unfortunately, catalogs do not always list interdepartmental contacts that are available to the student. Further, they often list programs that are either no longer extant or that are so little used that they are of little practical value. Nonetheless, some programs were discovered in this search.

Discussion of Issues

A significant number of engineers from developing nations are being educated at American universities. *Open Doors' 1980-81* states that 25.8 percent of all foreign students at U.S. colleges and universities are studying engineering. *Profiles: The Foreign Student in the United States* reports that in 1979-80, 19.8 percent of all African students in the U.S. were studying engineering, 20.9 percent of all South and East Asians, 20.1 percent of all Latin American students, and a full 42.4 percent of the students from the Middle East. Of the foreign engineering students in the 1979-80 academic year, 20.1 percent were graduate students, 61.6 percent of the Asian engineering students are doing graduate work, 24.2 percent of the Africans, 24.0 percent of the Latin Americans, and 13.5 percent of the Middle Eastern engineering students. Another 17.4 percent of foreign students are studying management or business. These two fields are not only the most popular fields of study, but are important areas for the furtherance of the development process.

Development, and particularly development through large-scale projects, depends to an increasing extent upon the work of the engineer. Developing nations are anxious to use their own manpower whenever feasible during the course of these projects. For this reason, American-educated engineers, particularly if they have a graduate degree, are frequently advanced quite rapidly into positions of considerable responsibility. These engineers are not only called upon to design or solve technical problems, but to oversee the totality of the project. The broad range of skills needed to manage a large-scale development project may well exceed the managerial capacities of the engineer. If the project is to be completed and to function as intended, the engineer must be capable of seeing and managing the total operation. This must be done in an environment that does not have all of the

supporting infrastructure available that American engineers can take for granted.

Therefore, this project focused upon five broad questions:

1. Are foreign engineering students in need of some management skills?
2. If foreign engineering students are in need of some management skills, what types of skills are most needed/useful?
3. Can these skills be taught?
4. Are these skills currently being provided?
5. What alternatives exist for the provision of management skills training?

These issues are addressed in the discussion that follows. They are also at the heart of the survey of deans of engineering. The results of that survey, along with the recommendations of the project, follow this discussion.

There seems to be little doubt that the majority of engineers eventually find themselves in positions with managerial responsibility. American engineers may not begin their careers in managerial positions, but these responsibilities follow with time. Babcock (1973) points out, with data obtained from the National Engineers Registry Survey, that "by the time engineers are 40, the statistics show that two-thirds or more will have taken on managerial or supervisory duties of an increasingly responsible nature."

The increasing emphasis placed upon the managerial role of engineers in the United States is reflected in the increased professional interest in management and continuing professional education on the part of U.S. engineers and their professional societies. Can we assume that engineers in developing nations have a similar need for management skills? The consensus, both in the literature and from preliminary results of the survey of deans of engineering, is that engineers in these nations are even more likely to be placed in positions of managerial responsibility.

Engineers returning to a developing nation after an education in the United States will be working in an environment that differs in significant ways from the one that a recent graduate working in the U.S. enters. There will be a much smaller supporting infrastructure; engineers will be forced to work without all of the tools, consulting services, co-workers, etc., that a beginning engineer takes for granted here.

Developing nations frequently face a shortage of trained manpower. The engineer returning with a graduate degree from an American university may immediately be placed in a position of authority and responsibility. This type of position will demand not only a level of technical competence, but also the ability to oversee the totality of a project.

It appears that there are three ways in which the work environment of an engineer working in a developing nation differs from that of a beginning engineer in a developed nation:

1. The supporting infrastructure that is taken for granted in the United States will not always be present;
2. The responsibilities of a beginning engineer are likely to be not only greater, but broader;
3. The engineer in a developing nation is likely to be placed in a position of managerial responsibility and will be placed in this position much sooner than the American engineer.

These are the general differences in the work environment that should be considered in the training of engineers to work in developing nations. The implications of these differences extend beyond the need for management skills.

In accepting the premise that some management skills are needed, the question that logically follows is: What types of management skills are most useful? Obviously, the needs will vary with the situation in which the engineer is placed. We have, however, identified three broad groups of skills:

1. Traditional basic managerial skill areas: i.e., accounting, economics, finance, and marketing;
2. Technical-analytical skills: i.e., project management, production scheduling, quality control, etc.;
3. Human resources skills.

The traditional managerial skill areas are probably the least relevant for engineering students from developing nations. For engineering students to take the standard management school course in these areas, they would have to be heading toward a private enterprise position to make good use of the skills as taught. There are important materials here—particularly in the realm of cost accounting, project finance, and cost-benefit analysis. It is believed, however, that these subjects should be taught as an overview course with emphasis on the specific areas of most value to the engineer.

The technical-analytical skills are skills that can be taught within an engineering framework. These types of subjects are frequently covered in industrial engineering and engineering management courses. The value of these courses is substantial, as engineers must be provided the framework within which they can view the totality of the project. The engineer must be able to not only design and construct, but also to make sure that the system as a whole functions in the manner intended. It is the analytical process that helps determine whether or not the project is appropriate, how it can

best be designed to function within its environment, and how it can continue to function.

Human resources skills are extremely important for the manager. The manager, in order to be effective, must be able to lead and motivate his workers. In addition, the manager in a developing nation will frequently be forced to work within a bureaucratic structure that requires an element of political sensitivity. These areas, important as they are, are not ones that can be easily taught. There are, of course, courses in personnel management in most schools of management; however, the sensitization of students from other cultures will require a course structure that is not overly biased toward Western personnel practices.

All of the skills mentioned above were listed on the survey of deans of engineering. They were questioned not only about the importance and/or need for these skills, but also about the ease with which they can be acquired in an academic setting. Space was also provided for the respondents to list other skill areas and to note their importance.

There is no question that all of these subjects are taught either in management programs or in engineering schools. What is in question is how effective these presentations are—especially for technical students who can devote only a portion of their time to non-technical courses. The technical orientation of the engineer and the variety of cultural backgrounds involved make the effective presentation of these subjects difficult.

Three ways in which the presentation of these subjects can be made are:

1. A case study method;
2. A practical training experience;
3. Encouraging students to use home country experience in their academic work.

The utilization of real developing country materials enables the engineering student to see the relevance of the subject and to avoid the overtly business-oriented approach of most schools of management.

The use of case studies and home country experiences are techniques that can easily be utilized for groups of engineering students. While students can always be encouraged to draw upon their own experiences, it is not so easy to introduce case studies of interest unless the class is oriented toward development. Furthermore, in most cases, U.S. faculty have little knowledge of developing countries.

Practical training can be an excellent way to learn skills through on-the-job experiences. Unfortunately, it is extremely difficult to arrange adequate practical training experiences for students from developing nations. (For a discussion of practical training, see *Principles for Practical Training Experiences for Foreign Students*, NAFSA, 1982.)

From all indications, engineering students from developing nations are currently receiving little or no management skills training with their technical education. Most programs make no provision for this type of training. Many other programs offer the option of obtaining these types of skill through participation in a portion of the management school program. It seems, however, that few students avail themselves of this possibility. This survey attempted to find out whether or not these programs are open to engineering students and, equally important, whether or not they are encouraged to take these courses.

One field that has succeeded in providing these skills is the field of engineering management. This field provides a managerial education within a technical framework. Programs in engineering management are proliferating. Unfortunately, it seems that the majority of these programs are not developing their programs for foreign students, or even the full-time student, but rather for the part-time U.S. student who is also a practicing engineer. There are exceptions; George Washington University's Engineering Administration enrolls a significant number of foreign students. Programs such as this should be considered as one of the best currently available means of providing a combined managerial-technical education.

One of the characteristics of most U.S. graduate school programs is that they tend to offer the student a fair amount of flexibility in planning a curriculum. The deans in this survey were asked whether their schools give credit for courses taken outside the school of engineering. Indications are that most schools do. However, there are frequently hidden barriers that prevent students from making full use of the outside courses that are currently available. Most U.S. schools of management, for example, offer courses to outsiders only on a space-available basis, or offer courses in a sequence that makes full utilization of their offerings impossible for a nonmajor.

Another option is the joint degree program where a student obtains degrees simultaneously in both engineering and management. Programs of this sort do exist at a number of institutions. Providing there is cooperation between the schools of management and engineering, this type of program is relatively easy to arrange. A potential problem is the extra time and expense involved in sponsoring a student for the extra semesters required. Such cost may be prohibitive for students from developing countries.

Obtaining separate, sequential degrees in these two fields generally involves an even greater investment of time and money. This option does, however, allow students to obtain the two degrees at separate institutions which may have programs particularly well suited to the student's needs. This option also allows students to obtain a solid grounding in the technical field before moving into managerial studies.

Another option, which may in some cases prove beneficial, is sending students home to work after the technical degree for a few years, and then

bringing them back for managerial studies. This option involves high costs and many potential problems, but it would give engineers from developing nations an opportunity to see what managerial skills are most needed.

Finally, the possibility exists for funding a special training program specifically established to provide management skills to engineering students from developing nations who are completing their American education. This type of training would presumably be provided at an American university immediately following the completion of engineering studies. The curriculum could be tailored to provide specific and relevant management training most useful to engineers from developing countries. This training could also conceivably be held at third-country sites for regional groups so that cultural barriers could be minimized.

It is imperative that the nature of the work to be performed be considered at the earliest stages of both selection and placement of sponsored students. In what type of career will these students be employed? Will they have managerial responsibilities as well as technical ones? How strong is the supporting infrastructure in the home country? Is the student likely to need a broad problem-solving education, or a very specific state-of-the-art technical education? The future needs of the student and the home country should be considered when selecting an academic program.

Similarly, on-campus U.S. academic advisers, foreign student advisers, and academic faculty must be aware of these issues and of the recommendations of AID and the placement agency. It is hoped that students from developing nations who are in need of managerial skills will not be placed in programs where these skills are not available. However, students who are correctly placed may not be aware of the options available outside their department and/or the desirability of pursuing such options. Advisers must be aware of and interested in the needs of these students and must know what facilities are available to help the students obtain managerial capabilities.

Review of the Literature

Early in the project an extensive search and review of the appropriate literature was undertaken. It was hoped that this search would uncover literature pertaining to the need for management skills training for engineers and the provision of such training. This effort was only partly successful because of the paucity of directly relevant articles.

Computer and manual searches were made of the literature in management, engineering, and the social sciences. A computer search was also conducted in the dissertation data base. These searches were conducted with the assistance of the professional staff of the State University of New York at Buffalo library. A computer search of AID publications was done by AID staff for this project. The project research assistant also followed through by searching the collection of the Library of Congress for relevant materials.

In general, the articles of interest fell into four categories: general and engineering specific literature on foreign students; publications on engineering management as a field; engineering-oriented development literature; and works on management in the developing countries. This division was forced upon the reviewer by the lack of directly relevant material and by the unidisciplinary approach of these studies. That is, there is no body of literature written by engineers about management skills for foreign students, and management literature pertaining to developing nations does not consider engineers.

The general foreign student literature provides a thorough overview of problems facing foreign students, including the familiar problems that many have in adapting to American culture and educational system. Curriculum matters and issues of relevance were the most useful items discussed in this body of literature. Studies by the Council of Graduate Schools in the

United States, Boakari, Lee, Meyer, and the National Association for Foreign Student Affairs were particularly useful. These studies do not consider the issue of management training for engineers, but they do point out the problems that many foreign engineering students face.

Lee (1981), in her review of the literature pertaining to foreign students, provides an excellent overview of the needs and problems of foreign students studying in America and a variety of specific variables which affect their educational experience. For those unfamiliar with the general problems of foreign students, this provides a useful and comprehensive review.

The issue of relevance is discussed in a number of publications on foreign students. NAFSA (1980) includes in its report on a series of workshops a number of insights to the relevance and transferability of a U.S. technical education. It points out that the most important skill obtainable is the ability to solve problems. Further, it states that "for the foreign student from a developing country there is an almost universal need for some additional management training."

Baron (1979) looks at relevance in terms of the flexibility of graduate research programs in a survey of graduate schools. This work follows an earlier NAFSA study (1972) which examined foreign student policies on a departmental level. These studies concluded that there has been little adaptation of graduate school policies to accommodate foreign students.

Boakari (1981) points out quite clearly some of the cultural problems that can arise in transfering a U.S. education to a developing country.

A number of engineers have examined the relevance of a U.S. engineering education for a student from a developing nation. Findley (1975) describes the diversified nature of the work that will await chemical engineering students upon returning to work in their home countries. He stresses the need for flexibility in graduate programs and encourages students to obtain a broader, more basic competence rather than following all of the more advanced courses.

Hoelscher (1972) believes that engineering programs should not be modified to accommodate foreign students. The excellence of the general U.S engineering program is stressed while pointing out that the primary responsibility is to the students enrolled—and these students are mainly U.S. students. Foreign students are encouraged to do appropriate research as a way of enhancing the usefulness of their studies. McNown (1972), in his comments on Hoelscher's article, writes that these engineering departments can be faulted—most importantly for failing to adequately advise foreign students of the options available to them.

Mbele-Mbong (1972) believes that the responsibility of U.S. schools and departments extends beyond the students to the home government. He maintains that they have a responsibility to teach the managerial, organizational, and planning skills that students from developing nations will need to implement their technical education.

Goldschmidt (1972) reveals in his survey results one of the most formidable problems facing the development of programs for foreign students. He reported that only 54 percent of engineering deans and representatives considered their foreign students to be a definite asset.

What these studies point out is the need for managerial skills, practical experience, flexible curricula, relevant dissertation topics, special advisement, and broad-based programs of study.

The literature in the field of engineering management proved useful in that it reveals the applicability of this field of study. Kocaoglu (1980) surveyed the current master's degree programs in the field. He reported that programs are generally "designed to respond to the needs of the local engineering community." This reflects the fact that only one-fourth of the students are full time. Sixteen percent of engineering management students come from foreign countries, a lower percentage than in other fields of engineering. Easter and Sarchet (1980) published a similar report on undergraduate programs. Williamson and Pearce (1980) reported on the results of a survey of graduates of engineering management programs. Perhaps their most relevant finding was the fact that the respondents felt that the engineering management program met their needs better than an MBA program could. Reasons cited included the variety of irrelevant subjects presented in MBA programs and the need for too many prerequisites. The primary reason, however, was their preference for the technical orientation of an engineering management program.

Washbush (1976) surveyed MBA students who had undergraduate degrees in engineering. His study stresses the need for more management-engineering interaction. These needs are further examined in many of the comments in the report of the National Conference for Deans of Business and Engineering (1981). Participants actively considered various ways of increasing interaction—although foreign students were not considered.

Fowlkes (1973) notes that there was little opposition in engineering circles to the provision of management skills training to engineers and that, indeed, the trend was toward increasing this training. He also concludes that engineering management is not an appropriate field for the undergraduate student but should build upon an undergraduate technical education.

Whipple (1980) describes the results of an American Society of Civil Engineers survey which revealed that American engineers felt quite strongly that their own preparation was weakest in support studies such as management, economics, etc. Further, they reported that recent graduates were also quite weak in these areas and were even weaker in oral and written communication skills.

The development literature offers insights into the special needs and problems of engineers in developing nations and how U.S. universities can help meet these needs. The literature search focused primarily on the views of engineers interested in development. Most of the best discussions of these

issues were found in the pages of *Technos*, the publication of the International Division of the American Society of Engineering Education.

Engelmann (1972) provides a good statement of the different sorts of problems facing engineers working in developing nations. He stresses the fact that these engineers will have a higher initial level of responsibility, will be more involved in management, and will have to adapt the techniques learned in the U.S.

Several writers discussed classes and/or methods which they have found useful in training students for developmental work. Maloney (1976) describes a course in project management that attempts to give students a broad perspective of project analysis and development. Rondinelli (1976) calls for more use of case studies in the study of development project management. Kendall (1976) also discusses the need for case studies.

Goodman (1976) discusses a number of programs in project management. He describes a prototype program at the East-West Center for the training of project managers and emphasizes the need for this type of course. Shaner (1975) outlines a course in project planning taught at Colorado State University. He discusses the kinds of skills needed for this type of work and how they can best be presented.

Several writers on development took the point of view that what is needed is not more engineers but more technologists. Mackson (1975) conducted a survey of foreign graduates which pointed out, among other things, a need for more people trained in intermediate technology. NAS (1976) points out the need for practical, rather than theoretical, technology and suggests a greater use of engineering technology. Rixse (1978) asserts that he sees "a need for sharply increasing the training of technicians and a mid-level technical management and supervisory cadre." These writers point out that serious questioning should be done about the real technical needs of developing countries.

The literature in management did not provide much material of direct interest to this project. El-Sayed (1979) discusses some of the problems facing the implementation of management science in Egypt. These include the choice of technology, developing priorities, the problem of structural imbalances, the political factors involved, and the scarcity of resources, among others. The emphasis here and in most of the literature is that there are significant differences between what will work managerially in a developed and a developing nation.

Papageorgiou (1972) discusses the need for trained managers in developing countries, but also describes the many roadblocks standing in the way of a successful utilization of management science in these countries. He favors training managers in the home country, partly because of the inappropriateness of U.S. management training.

Eldin (1977) studied the implementation of management science in a number of developing nations. The most serious obstacle he found was the

political, cultural, and social structures of these nations.

Paul (1977) provides a useful framework for designing a curriculum for public management in developing countries. He identifies six functions that the manager must master: planning and policy; environment appraisal; service delivery and logistics; technology and production; budgeting information and control; and organization and personnel.

This literature search, as wide-ranging as it was, revealed that there is little direct consideration in the literature of the provision for management skills to foreign engineering students. There is, however, a body of literature, particularly in the consideration of development studies by engineers, that considers the needs and the problems of these students.

Survey Results

The survey instrument (see Appendix D) was mailed in early March of 1982 to 197 deans of engineering at U.S. universities offering graduate engineering programs. For the most part the names and addresses of engineering deans were obtained from the American Society of Engineering Education (ASEE). A complete list of colleges surveyed is provided in Appendix B.

Responses were received from 67 institutions, a response rate of 35 percent. This was an encouraging indication that deans, as busy as they are, are interested in this matter. Not all respondents answered every question, and two respondents did not complete the survey.

The majority of the questions asked provided the opportunity to answer on a one-to-seven scale. Those data were then grouped into three groups: those rated one or two were considered positive responses; three, four, and five were considered neutral responses; six and seven were grouped as negative responses. Of course, the meaning of the groupings varies with the wording of the particular question.

Following are the analyses of the responses, including the mean and the mode for each question. The nature of the data prevents a strictly statistical analysis of these numbers; nonetheless, the values are of some interest.

Question 1.

Do you agree with the statement that "the ability to manage is becoming increasingly important in the daily work of the successful practicing engineer"?

Scaled response: 1 (agree strongly) - - - 7 (disagree strongly)

Agree (1, 2)	= 72%	Responses	= 61
Neutral (3, 4, 5)	= 25%	Mean of the Integer Responses	= 2.21
Disagree (6, 7)	= 3%	Mode	= 2

The goal of this question was to determine whether or not the deans felt that there is a strong managerial component in the work of the practicing engineer. Obviously, they feel that there is.

Comments on this question focused on the use of the word increasingly. Several deans commented that the ability to manage has always been important. Perhaps the positive rating would have been even higher if "increasingly" had not been included in the wording. However, the use of this word enables us to determine whether or not the deans feel that the importance of management skills to the practicing engineer is increasing or decreasing. Clearly, they feel it is increasing.

Question 2.

Foreign students make up a large portion of the graduate engineering students at most universities today. Do you think that these students have a greater or lesser need for developing management skills than U.S students?

Scaled response: 1 (much greater) - - - 7 (much lesser)

Greater (1, 2)	= 31%	Responses	= 59
Same (3, 4, 5)	= 65%	Integer Mean	= 3.25
Lesser (6, 7)	= 3%	Mode	= 4

The majority of respondents indicated the need was about the same in both groups. However, of those who felt strongly there was a difference, a 9 to 1 margin recognized a greater need for this training in foreign students.

The answers to questions one and two indicated that deans do recognize that engineers need to be managers as well as technicians and that foreign student needs in this area are at least as great as U.S. student needs.

Question 3.

Would you please rate the following skills as to their importance and usefulness to an engineer from and working in a developing country.

Scaled response: 1 (very important) - - - 7 (not at all important)

	1, 2	3, 4, 5	6, 7	Responses	Mean	Mode
Accounting, i.e., cost accounting	32%	67%	2%	57	2.96	3
Production scheduling	47	49	4	57	2.70	2
Financial management	47	51	2	57	2.61	3
Human resources management	60	40	0	55	2.20	1
Marketing	14	77	9	57	3.68	4
Project management	75	25	0	57	1.95	2
Quality control	63	37	0	57	2.28	2
Systems management	47	49	4	57	2.75	2
Microeconomics	28	65	7	57	3.42	4
Macroeconomics	21	72	7	57	3.58	4
Administrative sensitivity, i.e., working in a bureaucratic structure	60	38	2	55	2.44	2
Entrepreneurship	44	51	6	55	2.82	3

The responses indicated that none of these skill areas was deemed inappropriate, but that some of them were clearly more important than others. When the subjects were ranked by percentage indicating the subject as being important (ties being broken by the second category percentages) the following ordering is revealed:

1. Project management — 75% felt it was important
2. Quality control — 63
3. Human resources management — 60
4. Administrative sensitivity, i.e., working in a bureaucratic structure — 60
5. Financial management — 47
6. Production scheduling — 47
7. Systems management — 47
8. Entrepreneurship — 44
9. Accounting, i.e., cost accounting — 32
10. Microeconomics — 28
11. Macroeconomics — 21
12. Marketing — 14

A rating by mean integer scores gives a very similar result, except that human resources management ranks second in importance while quality control falls to third. Human resources management is the only skill area in which the modal score was a one.

In general, the ranking presented indicates that there are two primary areas of importance—the ability to manage a successful project in its entirety, and the ability to work with and manage other individuals.

Question 4.

Do you believe that these skills can be effectively acquired by the foreign graduate engineering student in a university setting?

Scaled response: 1 (yes, can be effectively acquired) - - - 7 (no, impossible to acquire)

	1, 2	3, 4, 5	6, 7	Responses	Mean	Mode
Accounting, i.e., cost accounting	81%	18%	2%	57	2.00	1, 2
Production scheduling	48	47	5	58	2.85	2
Financial management	55	41	3	58	2.60	2
Human resources management	31	64	5	58	3.19	3
Marketing	38	59	3	58	2.98	3
Project management	44	54	3	57	2.87	2
Quality control	50	48	2	58	2.62	2
Systems management	38	60	2	58	2.88	3
Microeconomics	72	28	0	58	2.09	2
Macroeconomics	74	26	0	58	2.12	2
Administrative sensitivity, i.e., working in a bureaucratic structure	14	56	30	57	4.39	4
Entrepreneurship	10	53	37	51	4.65	6

Since the same areas were addressed as in question 3, it is possible to compare the importance of a particular skill area with the ease with which that skill can be acquired. Unfortunately, it would seem that many of the most desired skills are among the most difficult to acquire. However, the deans indicated that only two skills—administrative sensitivity and entrepreneurship—would be very difficult to acquire. Accounting and micro- and macroeconomics were seen as easily acquired skills. The three skills areas rated as most important in response to question 3—project management, quality control and human resource management, were judged to be neither easy nor impossible to acquire.

Space was provided at the end of both questions 3 and 4 for other skill areas to be mentioned and rated. Fourteen responses were provided in this area. There was no consensus as no individual skill was mentioned more than once.

Question 5.

Do you believe that universities are currently effective in teaching these skills to foreign engineering students?

Scaled response: 1 (yes, very effective) - - - 7 (no, not all effective)

Effective (1, 2)	= 4%	Responses	= 57
Neutral (3, 4, 5)	= 61%	Integer Mean	= 4.87
Not effective (6, 7)	= 36%	Mode	= 5

Responses to this question indicate that deans see little evidence that universities are currently effective in teaching managerial skills to their foreign engineering students.

Comments provided to this question indicate that some deans question whether or not universities are even attempting to provide this skill training. This issue is addressed more directly in question 7.

Question 6.

Do you believe that graduate schools of engineering can impart some basic management skills within the framework of a master's degree in engineering program?

Scaled response: 1 (yes) - - - 7 (no)

Yes (1, 2)	= 43%	Response	= 60
Neutral (3, 4, 5)	= 45%	Integer Mean	= 3.10
No (6, 7)	= 12%	Mode	= 1

Responses indicate that most deans feel it is possible to include training of this type. While only 43 percent gave highly positive responses, there is a clear tendency toward positive responses. More deans gave a response of 1 than any other single response.

Question 7.

Are these institutions doing this currently?

Scaled response: 1 (yes) - - - 7 (no)

Yes (1, 2)	= 9%	Response	= 57
Neutral (3, 4, 5)	= 52%	Integer Mean	= 4.80
No (6, 7)	= 40%	Mode	= 6

Question 7 follows up on the two preceding questions—i.e., are graduate schools of engineering currently providing management skills training to their foreign engineering students. The deans' responses indicated that they feel that, in general, schools are not currently providing this kind of training.

It would seem that individual programs may be more effective than graduate engineering schools. However, when viewed as a whole, engineering deans do not feel that engineering schools are currently providing management skills training.

Question 8.

How useful do you believe graduate management/business school courses to be in teaching basic management skills to engineering students?

Scaled response: 1 (very effective) - - - 7 (not at all effective)

Effective (1, 2)	= 26%	Responses	= 55
Neutral (3, 4, 5)	= 60%	Integer Mean	= 3.51
Not effective (6, 7)	= 15%	Mode	= 3

The distribution of responses indicates that most deans feel that management schools are somewhat effective at teaching management skills, but that very few deans feel that these management programs are a very effective means of teaching management skills to engineers.

Question 9.

Certain foreign engineering students are viewed by their sponsoring agencies as having a particularly urgent need for management skills training with their technical education. How well do you believe your school meets the needs of these students within the context of the master's in engineering program?

Scaled response: 1 (very well) - - - 7 (very poorly)

Well (1, 2)	= 18%	Responses	= 57
Neutral (3, 4, 5)	= 44%	Integer Mean	= 4.53
Poorly (6, 7)	= 39%	Mode	= 6

Responses indicate that a small portion of the deans feel that their programs are well-suited to meet this need, but that most deans are either uncertain or feel that their programs do not meet the needs of these students.

Question 10.

At your institution is credit given for courses taken in departments outside the school of engineering?

Yes	= 78%	Responses	= 60
No	= 5%		
Sometimes	= 17%		

The majority of engineering schools do give credit for classes taken outside the major department. However, several deans commented that outside courses could only be in mathematics or the physical sciences. A conclusive answer to whether or not credit is given for management courses can not, unfortunately, be ascertained through this question. The consensus of the advisory committee, based on their experiences, is that most engineering schools do not give credit for general management courses.

Question 11.

How many credit hours of electives outside the department are allowed?

Responses = 56

The policies of engineering schools vary widely as to the exact number of outside electives for which credit will be given. However, only five deans indicated that credit would be given for more than four outside courses. Many deans commented that the awarding of outside credit varies among the individual departments and programs within the school of engineering. Generally, credit is given for only one to four outside courses.

Question 12.

Are courses in the graduate school of management/business open to your students?

Yes	= 86%	Responses = 55
No	= 11%	
No School of Management	= 4%	

There would seem to be very few schools at which the school of management/business is closed to engineering students. Respondents' comments, however, reveal two problems—that courses may be open but only on a limited, space-available basis, and that engineering students may lack the necessary prerequisites to take many of the courses. Given the high demand for management degrees on the part of American students, most schools of management/business courses are oversubscribed and thus closed to non-majors.

Question 13.

Are these students generally encouraged to acquire management skills?

Scaled response: 1 (yes, always) - - - 7 (no, never)

Yes (1, 2)	= 18%	Responses	= 60
Neutral (3, 4, 5)	= 53%	Integer Mean	= 4.27
No (6, 7)	= 28%	Mode	= 5

It would seem that most schools do not systematically encourage their foreign engineering students to obtain management school training. Only 18 percent of the deans indicated that these students are always or usually encouraged to acquire management skills. Most respondents chose to circle 5 or 6—indicating that students are generally not encouraged to acquire management skills.

Question 14.

Do you know of programs at other institutions that you believe are particularly effective at teaching management skills to foreign engineering students?

Yes	= 12%	Responses	= 56
No	= 88%		

Seven respondents mentioned a total of eleven institutions; two of these were their own schools. The only school mentioned by more than one person was the University of Missouri at Rolla, which was mentioned by four individuals, presumably for its engineering management program. Other schools mentioned were Carnegie-Mellon, MIT, Miami (Florida), Oklahoma State, Southwest Louisiana, Stanford, and Utah.

Question 15.

Can you direct attention to any studies, surveys, articles, or institutions that may be useful in studying this matter?

Only two respondents answered this question. One directed attention to an individual who is surveying engineering management teaching practices; the other mentioned two journal articles.

Question 16.

Do you know of individuals who are particularly interested in either foreign engineering student matters or the teaching of management skills to engineers?

Nineteen respondents answered this question and provided 26 names. Six of the respondents listed themselves; 15 individuals at the respondent's own university were mentioned; 5 individuals at other institutions were named. One individual said yes, but provided no names.

Question 17.

Would you please rate the following possible solutions as to how well you believe each, by itself, would prepare the foreign engineering student to assume a position of managerial responsibility in his or her home country?

Scaled response: 1 (very well) - - - 7 (very poorly)

	1, 2	3, 4, 5	6, 7	Mean	Mode
The standard master of engineering	4%	57%	39%	4.69	3
An M.Eng. followed by an M.B.A.	59	39	2	2.35	2
An M.B.A. followed by an M.Eng.	26	59	15	3.51	3
An undergraduate B.S.Eng. followed by an M.B.A.	33	59	7	3.09	3
A joint undergraduate B.S.Eng./M.B.A.	32	56	13	3.37	3
An M.Eng. with an extra semester to allow for management skills training	33	64	4	3.22	3
A practical training experience within an M.Eng. program	18	80	2	3.27	3
A practical training experience following an M.Eng.	40	59	2	2.94	2
A specialized M.Eng. with a second master's in engineering management	81	19	0	1.91	2
A B.S.Eng. followed by one to three years working in home country, followed by:					
• An M.S.Eng.	27	71	2	3.08	3
• An M.B.A.	64	36	0	2.43	2
• An M.S.Eng. with extra time for management skills training	71	29	0	2.18	2
• A special summer institute for foreign engineering students where management skills would be taught immediately following the B.S.Eng. and preceding the return home	15	82	4	3.46	3
• A similar institute immediately following the M.Eng.	40	60	0	2.83	3

A variety of possible academic solutions was given to the deans to be rated as to how well it would prepare their foreign engineering students for a managerial position in the home country. In retrospect, it would seem that, even though the list was hardly exhaustive, it is difficult to differentiate among 15 possible combinations. Direct comparison of any two or three possible programs is not likely to provide a valid representation of how deans rate these alternatives.

Nonetheless, the four proposals which received highly positive evaluations can probably legitimately be viewed as indications of the kinds of programs which the deans feel can be successful. Of all deans, 81 percent give a 1 or 2 rating to a combination of a specialized master's of engineering followed by a master's of engineering management. The nearly unqualified support given to this type of program indicates a promising area worthy of further consideration by placement officials. Fifty-nine percent of the deans felt that a master's in engineering followed by an M.B.A. provided a good preparation. The two other combinations which received positive ratings both involved a period of work in the home country following the B.S. and preceding further training. An M.B.A. as further training received a 64 percent favorable rating, while a master's in engineering with extra time for management skills training garnered a 71 percent favorable rating.

The one possibility which received a substantial negative rating was the standard master of engineering program. This confirms the responses to earlier questions that the master of engineering program as currently structured does not adequately prepare the foreign engineering student for a managerial position in his/her home country.

Question 18.

May we contact you to discuss this matter?

Yes	= 77%
No	= 23%

In addition, 71 percent of the respondents checked a box offering a copy of the final report. All but two of the respondents identified themselves. Many of the respondents were contacted, and they provided us with additional useful information.

Conclusions and Recommendations

The results of the survey of deans of engineering and contacts with deans, faculty, placement officials and academic and foreign student advisers, have made it clear that the provision of management skills to foreign engineering students is an area that needs to be addressed. There is an awareness by nearly everyone involved that a very real need is not being adequately met. The question of management skills training for foreign engineering students is one that, while all concerned admit is an important one, has not been fully addressed either in the literature or in the provision of management skills training on a systematic or widespread basis.

There seems to be no doubt that managerial functions are an important part of the work of the successful practicing engineer. Engineering management literature has covered and justified the need for this type of training. The growth of engineering management as a field serves to underline the fact that this field is meeting a need felt by American engineers.

Engineers working in developing countries face a whole host of problems—most particularly the lact of infrastructure and support services which are taken for granted by engineers working in more developed nations. Furthermore, the lack of trained manpower frequently leads to situations in which newly graduated engineers are placed immediately in positions of great responsibility. These engineers may be called upon not only to do technical work, but also to oversee a government agency or a large development program or project. There is concern that these engineers are not being provided with the managerial preparation necessary to effectively manage these operations.

Most graduate engineering programs do little to meet these needs. This is not a criticism, because most of these programs are best suited to provide a

technical education. Engineering programs, as structured at present, are not geared to teach managerial and technical skills in the same program. With the exception of some industrial engineering programs, the best available option for most students is to enroll in a joint-degree program with a school of management.

There are, however, some programs worthy of further investigation. Engineering management/administration programs exist at a number of schools. Most of these programs are oriented toward working engineers who study part-time. There are, however, a few programs which work with full-time students and which enroll a fair number of foreign students: these include George Washington University, University of Missouri/Rolla, and Stanford, among others. (There may well be other U.S. schools offering engineering/management degrees which did not come to the committee's attention.) These programs provide technical and managerial courses oriented toward engineers. Options within these programs, such as construction management, provide what would seem to be very appropriate skills. What needs to be considered carefully here is any tradeoff between technical and managerial skills. The appropriate tradeoff depends on the background of the students, i.e., how solid their undergraduate preparation is and the type of work to which students will be returning. A further option which may be considered is the engineering management degree as a second master's degree. This takes less time than acquiring an M.B.A. following an M.Eng., and also provides the managerial training within a technical framework.

Management of technology programs exist at a number of universities, and some of these programs have had experience with foreign students, e.g., Vanderbilt University, M.I.T., and the Polytechnic Institute of New York. Vanderbilt's program is interested in training the person who will be responsible for coordinating broad development programs—i.e., the person who can understand and work with all of the technical people and be able to oversee the financial and logistical aspects of a development program.

Many industrial engineering programs have some facilities for teaching managerial skills on a limited basis. Oklahoma State University has been noted for its master of industrial engineering and management program. Purdue University offers a minor in industrial management to majors in all other engineering departments.

Certain kinds of specialized programs do offer managerial components; there are a few in construction management, for instance. Another program oriented toward chemical engineers is the M.S. in the economic aspects of chemistry program at the University of Detroit. The University of Pittsburgh offers a program in public works engineering and administration, which may be worthy of further investigation.

The programs mentioned are among those which may be able to provide a managerial framework within a technical education. There may be

others not known to the research team. Programs focused on one specialized aspect of engineering will not be suitable for all. Broader engineering management programs may provide some of the necessary skills for those students who do not fit into the niches of specialized programs.

The research team is not in a position to recommend particular programs, nor was that the purpose of this survey. Rather, the team encourages academic advisers, foreign student advisers, placement officials, and funding agencies to be keenly aware of the fact that the majority of foreign graduate engineering students will someday be in positions of managerial responsibility. This need should be identified as soon as possible in a student's academic career, preferably before placement in an academic program.

Deans of engineering admit that the standard M.Eng. program is not a good way of providing managerial skills to technical people. They have also pointed out that there are special programs which can perhaps meet this need.

Foreign students, many of whom realize that they will be called upon to manage, need to be aware of the options available for obtaining managerial skills. Where programs exist there should be strong efforts to make the students aware of their existence. Greater flexibility in curricula is required to allow students to enroll in these kinds of courses.

Dual-degree programs and specialized technical programs with engineering management should be encouraged. Interdisciplinary work should be encouraged. Consideration should be given to downplaying the role of the traditional single-subject degree program.

It is hoped that this study will be the starting point for wide-ranging discussion of the issue of management skills training for foreign engineering students from developing nations. Discussion of the issues and an analysis of those programs which are trying to meet the needs of these students will go far to increase awareness of these needs. Further, it is to be hoped that the matter will be pursued in the NAFSA, AID, and engineering forums.

The team recommends that the following two courses of action be taken: First, that a survey of U.S.-trained engineers who have returned to the home country to practice engineering be immediately undertaken. This survey should attempt to discover: how well their managerial needs were met by their U.S. education; what kinds of managerial skills they are using; how they were able to obtain these skills; and if they recommend this type of training. Second, that a more detailed examination be made of U.S. programs which are attempting to provide a managerial framework within their technical programs. When successful programs of this type are identified, they should be given the full support of placement and funding officials. It would be far wiser to identify successful programs and place students from developing nations in them than to attempt to modify the way engineering education is provided at all U.S. schools.

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Appendices

Appendix A.
AID Participants in Master's Programs in Engineering

Institution	Total Students Listed	Total Students in Programs (as of February 1982)
Auburn University	2	1
Arizona State University	8	6
University of Arizona	1	0
California State Polytechnic University at Pomona	1	1
California State University at Long Beach	1	1
Stanford University	1	0
Colorado School of Mines	1	0
Colorado State University	1	1
University of Colorado	1	0
Economics Institute (Colorado)	1	0
Bridgeport University	1	0
University of Florida	1	1
University of Miami	3	3
Embry-Riddle Aeronautical University	1	1
Georgia Institute of Technology	1	0
Northwestern University	2	1
Southern Illinois University at Carbondale	2	1
University of Illinois—Chicago	1	1
Ball State University	1	0

APPENDIX A

Institution	Total Students Listed	Total Students in Programs (as of February 1982)
Iowa State University	1	0
University of Iowa	1	1
Kansas State University	3	1
University of Kansas	2	0
University of Kentucky	1	1
Louisiana State University and A & M College	1	0
University of Lowell	2	0
Boston University	2	2
Massachusetts Institute of Technology	2	0
Northeastern University	1	1
Michigan State University	1	1
University of Michigan	3	2
Wayne State University	1	1
Lansing Community College	1	0
University of Minnesota	2	0
University of Missouri at Rolla	4	4
University of Missouri at Columbia	5	2
Montana School of Mines	1	1
University of Nebraska	4	2
Rutgers University	2	1
Cornell University	2	1
Polytechnic Institute of Technology	6	5
State University of New York at Buffalo	6	2
Syracuse University	4	1
North Dakota State University	1	1
Oklahoma State University	1	0
Oregon State University	1	0
Drexel University	2	2
Lehigh University	1	1
University of Pittsburgh	5	2
University of Rhode Island	1	1
Tennessee State University	1	1
Sam Houston University	1	1
Texas A & M University	2	2
Texas State Technical Institute	1	1
University of Utah	1	1

Institution	Total Students Listed	Total Students in Programs (as of February 1982)
Utah State University	6	6
St. Michael's College	1	0
Virginia Polytechnic Institute	1	1
Old Dominion University	2	1
University of Washington	1	0
Washington State University	5	5
West Virginia University	3	2
University of Wisconsin	3	2
George Washington University	5	4
Georgetown University (ALIGU)	12	2
Howard University	1	1
U.S. Department of Agriculture	3	0

Appendix B.
Institutions Surveyed

Arizona State University
Auburn University
Boston University
Bradley University
Brigham Young University
Brown University
Bucknell University
California Institute of Technology
California Polytechnic State University—San Luis Obispo
California State Polytechnic University—Pomona
California State University—Fresno
California State University—Fullerton
California State University—Long Beach
California State University—Los Angeles
California State University—Northridge
California State University—Sacramento
Carnegie-Mellon University
Case Western Reserve University
Catholic University of America
Chico State University
City College of the City of New York
Clarkson College of Technology
Cleveland State University
Colorado School of the Mines
Colorado State University
Columbia University

APPENDIX B

Cornell University
C.W. Post College, Long Island University
Dartmouth College
Drexel University
Duke University
Eastern Michigan University
Fairleigh Dickinson University
Florida Atlantic University
Florida Institute of Technology
Florida Technological University
George Washington University
Georgia Institute of Technology
Gonzaga University
Harvard University
Howard University
Idaho State University
Illinois Institute of Technology
Iowa State University
Johns Hopkins University
Kansas State University
Lamar University
Lehigh University
Louisiana State University
Louisiana Technical University
Loyola Marymount University
Manhattan College
Marquette University
Massachusetts Institute of Technology
Memphis State University
Michigan State University
Michigan Technological University
Mississippi State University
Montana State University Naval Postgraduate School
New Jersey Institute of Technology
New Mexico State University
New York Institute of Technology
North Carolina A & T University
North Carolina State University
Northeastern University
North Dakota State University
Northern Illinois University
Northwestern University
Oakland University
Ohio State University

Ohio University
Oklahoma State University
Old Dominion University
Oregon State University
Pennsylvania State University
Polytechnic Institute of New York
Prairie View A & M University
Princeton University
Purdue University
Rensselaer Polytechnic Institute
Rochester Institute of Technology
Rutgers University
San Diego State University
San Jose State University
Seattle University
South Dakota School of Mines & Technology
South Dakota State University
Southern Illinois University—Carbondale
Southern Illinois University—Edwardsville
Southern Methodist University
Stanford University
State University of New York—Buffalo
State University of New York—Stony Brook
Stevens Institute of Technology
Syracuse University
Tennessee State University
Tennessee Technological University
Texas A & I University—Kingsville
Texas A & M University
Texas Tech University
Tufts University
Tulane University
Tuskegee Institute
Union College
University of Akron
University of Alabama
University of Alabama at Birmingham
University of Alabama at Huntsville
University of Alaska
University of Arizona
University of Arkansas
University of Bridgeport
University of California—Berkeley
University of California—Davis

University of California—Los Angeles
University of California—Santa Barbara
University of Cincinnati
University of Colorado
University of Connecticut
University of Dayton
University of Detroit
University of Delaware
University of Florida
University of Georgia
University of Hawaii
University of Houston
University of Idaho
University of Illinois—Chicago Circle
University of Illinois—Urbana/Champaign
University of Iowa
University of Kansas
University of Kentucky
University of Louisville
University of Lowell
University of Maine—Orono
University of Maryland—College Park
University of Massachusetts—Amherst
University of Miami
University of Michigan—Ann Arbor
University of Michigan—Dearborn
University of Minnesota
University of Mississippi
University of Missouri—Columbia
University of Missouri—Rolla
University of Nebraska—Lincoln
University of Nevada—Reno
University of New Hampshire
University of New Haven
University of New Mexico
University of New Orleans
University of North Carolina—Charlotte
University of North Dakota
University of Notre Dame
University of Oklahoma
University of Pennsylvania
University of Pittsburgh
University of Portland
University of Puerto Rico—Mayaguez

University of Rhode Island
University of Rochester
University of Santa Clara
University of South Carolina
University of Southern California
University of South Florida
University of Southwestern Louisiana
University of Tennessee—Chattanooga
University of Tennessee—Knoxville
University of Texas—Arlington
University of Texas—Austin
University of Texas—El Paso
University of Toledo
University of Tulsa
University of Utah
University of Vermont
University of Virginia
University of Washington
University of Wisconsin—Madison
University of Wisconsin—Milwaukee
Utah State University
Virginia Polytechnic Institute
Vanderbilt University
Villanova University
Washington State University
Washington University
Wayne State University
Western Kentucky University
Western Michigan University
Western New England College
West Virginia University
Wichita State University
Widener College
William Marsh Rice University
Worcester Polytechnic Institute
Yale University
Youngstown State University

Appendix C.
Sample Cover Letter Sent to Deans of Engineering

March 1, 1982

Dear Colleague:

I am writing to ask your assistance in improving engineering training programs for graduate students from developing countries. As you are certainly aware, foreign students now make up a substantial portion of most of our graduate engineering student bodies. These students come from backgrounds that are significantly different from those of our American students. When these students return to their home country, they practice in an environment that is different in many ways from the way in which engineers practice here.

The Agency for International Development (AID) and the National Association for Foreign Student Affairs (NAFSA) have been aware of the need for engineers in developing nations to step into a managerial role much sooner than the typical U.S. engineer. Recent graduates are frequently placed in positions of substantial authority. In order to better meet the needs of these students and their nations, AID has sponsored, in cooperation with the National Association for Foreign Student Affairs, a management skills survey to determine what types of management skills training are currently being provided these graduate students and what possibilities exist for improving this training.

Your completing the enclosed questionnaire will help AID and NAFSA in improving training programs for sponsored graduate students from devel-

oping countries. It will also, we hope, stimulate discussion of the special needs of these students and the role of a technical education in the development process.

Please feel free to comment on any question in this questionnaire. If you feel that your university has a program or course that would be of particular value to engineering students in need of management skills, please let us know.

Please note that a stamped return envelope has been enclosed for your convenience. If you would be interested in receiving a copy of the final NAFSA/AID Management Skills Survey Report, please check the box at the end of the survey. Your cooperation is sincerely appreciated. Thank you.

Sincerely yours,

Stephen C. Dunnett, Assistant Professor and Director
Intensive English Language Institute

Sample Cover Letter Sent to Foreign Student Advisers

March 8, 1982

Dear Colleague:

We are all aware that most foreign students come from backgrounds that are significantly different from those of American students. Students returning to their home country often find that they are expected to operate in a work environment that does not provide the same infrastructural support that an American worker expects. Engineering graduates, in particular, frequently find that they are not only asked to work without all of the tools provided American engineers, but that they are also placed very quickly in positions requiring managerial responsibility.

The Agency for International Development (AID) and the National Association for Foreign Student Affairs (NAFSA) have been aware of these managerial demands placed upon recently graduated engineering students. To assist in meeting the needs of these students and their nations, AID has sponsored, in cooperation with NAFSA, a management skills survey to determine what types of management skills training are currently provided to graduate students in engineering and what possibilities exist for improving such training.

The NAFSA/AID Management Skills Project is surveying deans of graduate schools of engineering asking for their opinions on these matters and for information on the types of training currently being provided at their institutions. The attached survey has been sent to your dean of engineering. We are requesting that you assist the project by contacting your dean of engineering to indicate the importance of this project and to urge your dean's completion of the questionnaire.

The information obtained from this survey will be of great value to AID and NAFSA in helping us to better meet the special needs of those students and thereby improve the U.S. contribution to world development. Your help in this matter is sincerely appreciated. Thank you.

Very truly yours,

Joseph F. Williams, Director
International Student Affairs

Appendix D.
NAFSA/AID Management Skills Survey

Please circle the appropriate response.

1. Do you agree with the statement that "the ability to manage is becoming increasingly important in the daily work of the successful practicing engineer"?

agree strongly						disagree strongly
1	2	3	4	5	6	7

2. Foreign students make up a large portion of the graduate engineering students at most universities today. Do you think that these students have a greater or lesser need for developing management skills than U.S. students?

much greater						much lesser
1	2	3	4	5	6	7

3. Would you please rate the following skills as to their importance and usefulness to an engineer from and working in a developing country.

		very important						not at all important
a.	Accounting, i.e., cost accounting	1	2	3	4	5	6	7
b.	Production scheduling	1	2	3	4	5	6	7
c.	Financial management	1	2	3	4	5	6	7

		very important						not at all important
d.	Human resources management	1	2	3	4	5	6	7
e.	Marketing	1	2	3	4	5	6	7
f.	Project management	1	2	3	4	5	6	7
g.	Quality control	1	2	3	4	5	6	7
h.	Systems management	1	2	3	4	5	6	7
i.	Microeconomics	1	2	3	4	5	6	7
j.	Macroeconomics	1	2	3	4	5	6	7
k.	Administrative sensitivity, i.e., working in a bureaucratic structure	1	2	3	4	5	6	7
l.	Entrepreneurship	1	2	3	4	5	6	7
m.	Other: _____	1	2	3	4	5	6	7
	_____	1	2	3	4	5	6	7
	_____	1	2	3	4	5	6	7
	_____	1	2	3	4	5	6	7

4. Do you believe that these skills can be effectively acquired by the foreign graduate engineering student in a university setting?

		yes, can be effectively acquired						no, impossible to acquire
a.	Accounting, i.e., cost accounting	1	2	3	4	5	6	7
b.	Production scheduling	1	2	3	4	5	6	7
c.	Financial management	1	2	3	4	5	6	7
d.	Human resources management	1	2	3	4	5	6	7
e.	Marketing	1	2	3	4	5	6	7
f.	Project management	1	2	3	4	5	6	7
g.	Quality control	1	2	3	4	5	6	7
h.	Systems management	1	2	3	4	5	6	7
i.	Microeconomics	1	2	3	4	5	6	7
j.	Macroeconomics	1	2	3	4	5	6	7

		yes, can be effectively acquired						no, impossible to acquire
k.	Administrative sensitivity, i.e., working in a bureaucratic structure	1	2	3	4	5	6	7
l.	Entrepreneurship	1	2	3	4	5	6	7
m.	Other: _____	1	2	3	4	5	6	7
	_____	1	2	3	4	5	6	7
	_____	1	2	3	4	5	6	7
	_____	1	2	3	4	5	6	7

5. Do you believe that universities are currently effective in teaching these skills to foreign engineering students?

Yes, very effective						No, not at all effective
1	2	3	4	5	6	7

6. Do you believe that graduate schools of engineering can impart some basic management skills within the framework of a master's degree in engineering program?

Yes						No
1	2	3	4	5	6	7

7. Are these institutions doing this currently?

Yes						No
1	2	3	4	5	6	7

8. How useful do you believe graduate management/business school courses to be in teaching basic management skills to engineering students?

very effective						not at all effective
1	2	3	4	5	6	7

9. Certain foreign engineering students are viewed by their sponsoring agencies as having a particularly urgent need for management skills training with their technical education. How well do you believe your school meets the needs of these students within the context of the master's in engineering program?

very well 1 2 3 4 5 6 7 very poorly

10. At your institution is credit given for courses taken in departments outside the school of engineering?

Yes No Sometimes _____

11. How many credit hours of electives outside the department are allowed? _____

12. Are courses in the graduate school of management/business open to your students?

Yes No No school of management

13. Are these students generally encouraged to acquire management skills?

Yes, always 1 2 3 4 5 6 7 No, never

14. Do you know of programs at other institutions that you believe are particularly effective at teaching management skills to foreign engineering students?

Yes No

If so, where? _____

15. Can you direct to our attention any studies, surveys articles, or institutions that may be useful to us in studying this matter?

If so, please detail. _____

_____

_____

16. Do you know of individuals who are particularly interested in either foreign engineering student matters or the teaching of management skills to engineers?

_____

_____

_____

17. Would you please rate the following possible solutions as to how well you believe each, by itself, would prepare the foreign engineering student to assume a position of managerial responsibility in his or her home country?

		very well						very poorly
a.	The standard master of engineering	1	2	3	4	5	6	7
b.	An M.Eng. followed by an M.B.A.	1	2	3	4	5	6	7
c.	An M.B.A. followed by an M.Eng.	1	2	3	4	5	6	7
d.	An undergraduate B.S.Eng. followed by an M.B.A.	1	2	3	4	5	6	7
e.	A joint undergraduate B.S.Eng./M.B.A.	1	2	3	4	5	6	7
f.	An M.Eng. with an extra semester to allow time for management skills training	1	2	3	4	5	6	7
g.	A practical training experience within an M.Eng. program	1	2	3	4	5	6	7
h.	A practical training experience following an M.Eng.	1	2	3	4	5	6	7
i.	A specialized M.Eng. with a second master's in engineering management	1	2	3	4	5	6	7
j.	A B.S.Eng. followed by one to three years working in the home country, followed by:							
	1) An M.S.Eng.	1	2	3	4	5	6	7
	2) An M.B.A.	1	2	3	4	5	6	7

		very well						very poorly
	3) An M.S. Eng. with extra time for management skills training	1	2	3	4	5	6	7
	4) A special summer institute for foreign engineering students where management skills would be taught immediately following the B.S.Eng. and preceding the return home	1	2	3	4	5	6	7
	5) A similar institute immediately following the M.Eng.	1	2	3	4	5	6	7
k.	Other programs: _____	1	2	3	4	5	6	7
	_____	1	2	3	4	5	6	7
	_____	1	2	3	4	5	6	7

18. May we contact you to discuss this project?

Yes No

19. Name _____

Position (if other than Dean of Engineering) _____

Institution _____

Address _____

Phone _____

Thank you for taking the time to complete this questionnaire. Please check this box if you would like to have a copy of the final report. ☐

This survey should be returned to:

NAFSA/AID Management Skills Survey
c/o Intensive English Language Institute
320 Baldy Hall
State University of New York at Buffalo
Buffalo, NY 14260

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